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PREDICTING THE RISK OF COVID-19 AND OPTIMIZING THE USE OF HEALTHCARE RESOURCES

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Abstract: Background: COVID-19, a new strain of coronavirus, has been declared a global pandemic by the World Health Organization (WHO). The first documented case of the virus was in China in December 2019. Aims: Developing a prognostic chart and planning the use of medical resources for early detection and diagnosis of Covid-19. Materials and methods: The study was conducted using a case-control method. For this, we included 600 cases and 600 healthy controls infected with Covid-19 in 2020-2022, and analyzed their risk factors for developing the disease. Results: Based on our analysis, in 2021 the level of occupancy of positions in this hospital was 95.6% for doctors, 57.5% for junior medical staff, and 52.2% for junior medical staff. From this we can conclude that in 2021, junior medical staff and junior medical staff occupied almost half of the total staff. Conclusion: Widespread use of a prospective table that allows for a comprehensive assessment of the risk group among the population and patients will allow medical workers working in the ENT institutions and heads of healthcare institutions to develop scientifically based measures aimed at reducing the incidence of the disease, its early detection, diagnosis and adequate treatment.

Key words: COVID-19, SARS, MERS, risk factors, optimizing, prognos, optimal control

1. Introduction

COVID-19, a new strain of coronavirus, has been declared a global pandemic by the World Health Organization (WHO). The first documented case of the virus was in China in December 2019. COVID-19 is a highly contagious disease that is spread through respiratory droplets produced when an infected person coughs or sneezes, and can enter the body through the eyes, nose, mouth, or ears. The virus can survive on porous surfaces such as paper, wood, sponges, and cloth for 8 to 10 hours, and longer on nonporous materials such as glass, plastic, and metal. Its incubation period is usually 2 to 14 days. Symptoms of COVID-19 are similar to those of the common cold and flu, including chills, dry cough, shortness of breath, fatigue, body aches, headache, loss of smell or taste, and sore throat. The severity of the illness varies widely among people, depending on factors such as age and underlying health conditions. Approximately 80% of those infected experience mild symptoms or are asymptomatic and recover within two weeks. However, the elderly and those with pre-existing health conditions have a higher mortality rate, while younger people experience 2% of cases and less than 3% experience severe illness. It is noteworthy that the mortality rate for COVID-19 is relatively low, ranging from 2% to 3%, significantly lower than that of the 2003 SARS virus (10%) and the 2012 MERS virus (35%) [1]. In recent

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years, mathematical models have become invaluable in developing effective strategies to combat infectious diseases and mitigate their consequences. For COVID-19, mathematical models have been developed to predict and control the spread of the disease. In order to control the disease, some researchers have neglected the impact of health care, quarantine, and isolation measures on the spread of COVID-19. However, determining the most effective approach to control the disease, especially in the absence of drugs, requires a comprehensive examination of the principles of optimal control. Optimal control has proven to be effective in managing infectious diseases such as COVID-19. Strategies presented in the available literature, approved and implemented by various health authorities, have resulted in significant costs, including economic losses [2].

Mathematical models that study different intervention strategies for COVID-19 should critically evaluate the optimal control analysis of different influential parameters. This is necessary to gain insight into their contribution to the spread of the virus and to develop more effective strategies. Health professionals can also benefit from understanding the role of individual protection, early detection and treatment, delayed treatment, and control of the spread of the virus in reducing the spread of COVID-19 and the time it takes to achieve this. Based on the above discussion, this study examines the optimal control policy required and the proportion of infected individuals who should be quarantined to limit the COVID-19 epidemic [3, 4].

Many studies have examined the dynamics of COVID-19 spread and intervention through optimal control approaches. Several optimal control models have been developed, tailored to the specific strains of COVID-19 considered in 2020. The United States also proposed a mathematical model for managing the COVID-19 epidemic [5, 6]. Indonesia implemented two mathematical models for controlling COVID-19, one that did not involve public awareness and the other that included public awareness. These models include non-pharmaceutical and pharmaceutical interventions, such as face masks, treatments, and rapid testing [7, 8, 9, 10].

2. Materials and methods

The study was conducted using a case-control method. For this, we included 600 cases and 600 healthy controls infected with Covid-19 in 2020-2022, and analyzed their risk factors for developing the disease. A prognostic table was developed to identify and predict risk factors. In addition, an analysis of hospital resource utilization was conducted.

3. Results

In our country, the identification, assessment and diagnosis of risk factors leading to the disease at the primary level of healthcare are some of the difficulties. Therefore, one of the main factors for early detection of coronavirus and prevention of its complications is the lack of an individual differentiated approach to monitoring the population and patients.

The use of a specially developed mathematical model in analyzing data on risk factors leading to the disease gives a positive effect. This is reflected in the following assessment table (Table 1). There are a lot of risk factors leading to the disease. However, assessing the

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impact of each of them on the body and predicting it requires a lot of time from a medical worker.

This is especially difficult for medical workers and infectious disease specialists working in primary health care institutions. Among the risk factors, 10 risk factors with the highest weight were identified (Figure 1).

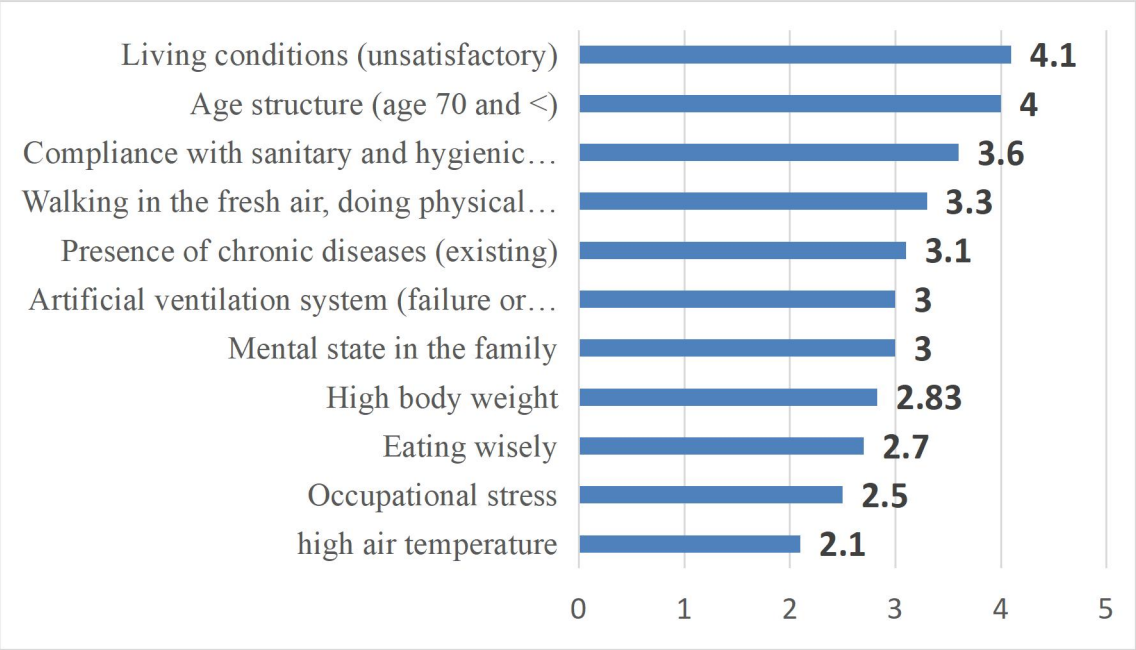

Figure 1. Leading risk factors influencing the occurrence of COVID-19 disease

In-depth analysis of the results of the studies, analytical research methods of clinical epidemiology: to identify risk factors, the prevalence of diseases, the ratio of opportunities and the leading risk factors of the disease were determined, and a table was developed to identify and assess their prospects (Table 1).

Table 1

A prognostic table that comprehensively assesses the level of risk factors affecting the occurrence of COVID-19.

№	Biological factors	Gradation of factors	Prognostic Score (X)	Odds ratio (R)
1	Age groups	19 >	2	4,0
		20-29	2,32	
		30-39	2,88	
		40-49	2,4	
		50-59	6,36	

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		60-69	7,88	
		70 <	7,92	
2	Body weight	normal	1,73	2,83
		above the norm	4,9	
3	The presence of chronic diseases	Available	5,7	3,1
		Not available	1,8	
Factors associated with adherence to sanitary and hygienic rules and the occurrence of disease symptoms				
4	What are the sanitary and hygienic conditions in dormitories?	valid	1,9	3,6
		invalid	7	
Factors related to living conditions, nutrition and rest				
5	Living conditions	unsatisfactory	14,6	4,1
		satisfactory	3,9	
		good	3,5	
		Very good	4,1	
6	Reasonable diet mode	Will be observed	1,48	2,7
		Non-compliance	4,05	
7	Mental state in the family	good	2,7	3,0
		not good	8,1	
8	Walking in the fresh air, doing physical activities	not	5,28	3,3
		1 hour	2,4	
		2 hour	1,58	
		3 hour <	2	
Harmful habits				
9	Tobacco smoking	I don't smoke	1,5	2,0
		Up to 5 pieces per day	1,84	
		Up to 10 pieces	2,26	

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		per day		
		Up to 20 pieces per day	2,2	
		Up to 20<	3,0	
10	Спиртли ичимлик истеъмоли	Per day	2,0	1,74
		4 times a week	1,74	
		2-3 times a week	1,48	
		In exceptional cases	1,14	
Risk values				
	Minimum Risk Value (X)	∑Xn	19,33	
	Maximum Risk Value (X)	∑Xn	62,55	

After the medical worker collects the client's anamnesis data and conducts a medical examination, the identified factors are noted in this table. After that, the sum of the values corresponding to all factors is obtained. Thus, the range of influence of the 10 obtained socio-hygienic and medical biological factors on the indicators of coronavirus infection is within the limits of 19.33-62.55. Thus, the larger the normative integration (prognostic) indicator, the higher the influence of the complex of factors obtained, and vice versa, the smaller the prognostic indicator, the lower the influence of the factors.

Table 2

Risk groups for patients and its ranges.

Hazard level	Hazard Scale	Risk group (perspective-forecast)
Minimum level of risk	19,33-32,3	good perspective Group
Average risk level	32,3-45,26	the group that requires attention
Peak risk	45,26-62,55	bad prospect group.
Risk limit	19,33-62,55	

In the study, we divided the risk thresholds into 3 interval groups: the lowest risk level (19.33-32.3), the average risk level (32.3-45.26), and the highest risk level (45.26-62.55) (Table 2). In accordance with the above, we divided the outlook (prognosis) into 3 groups: a good outlook group, a group requiring attention, and a poor outlook group. The use of these tables by doctors in the primary healthcare system allows them to identify risk groups before the onset of the disease or to divide patients into groups according to the severity of the

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disease after its onset, and to develop individual, differentiated special measures among them based on a systemic approach.

The level of occupancy of hospital positions allows us to analyze and plan the activities of this hospital and its departments, to identify and assess in a timely manner the shortcomings in the correct, complete and effective implementation of medical and social assistance provided to patients, depending on how fully they are covered. Based on our analysis, in 2021 the level of occupancy of positions in this hospital was 95.6% for doctors, 57.5% for junior medical staff, and 52.2% for junior medical staff (Table 3). From this we can conclude that in 2021, junior medical staff and junior medical staff occupied almost half of the total staff.

Table 3.

Republican special infectious Diseases Hospital of Zangiota-2

employment of positions. (2021).

Types of positions	total state number	Individuals	coherence coeficient	Employment of positions (%)
Doctors	413	315	1,05	95,6
Secondary medical personnel	744,8	428	1,74	57,5
Junior medical staff	463,8	242	1,92	52,2

The list of medical services guaranteed by the state is determined in each country based on the existing economic, political, social, environmental and other conditions and is financed from the state budget or through social insurance. The Anti-Crisis Fund established in our country has allocated sufficient funds for the construction and repair of specialized hospitals, additional and bonus payments, the purchase of medicines, hygiene and disinfection products, food products, medical equipment, the purchase of vehicles, the disinfection of public places, and other anti-epidemic measures. In addition, during the pandemic, 65 CT and X-ray machines, 170 PCR machines, 2,774 ventilators, 5,358 oxygen concentrators, 2,300 IVL and cardiac monitors, 2,303 functional beds, 1,639 syringe pumps, 1,512 pediatric ventilators, 300 IVL machines, 2,507 oxygen concentrators and other equipment were purchased for medical institutions. Prevention, diagnosis and treatment of the disease among the population were carried out free of charge, more than 800,000 were delivered to the regions for outpatient treatment, more than 1.3 million first aid kits for disease prevention, 30,000 favipiravir and 36,700 remdesivir packages were delivered to patients in need, and 1.2 million teachers and medical workers were vaccinated against influenza.

The purpose of analyzing the activities of a medical institution is to assess the magnitude of its indicators, compare and contrast them in dynamics with the indicators of other

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institutions, identify the interrelationships between indicators, various factors and causes affecting them, interpret the data and draw conclusions. Through analysis, it is possible to identify patterns and determine interrelated causes that allow us to determine targeted measures to improve the work of the institution. That is why in our analysis we analyzed and evaluated the activities of the Republican Specialized Hospital "Zangiota No. 2", which is intended for the treatment of patients with coronavirus infection. Since the establishment of the institution, a total of 47,821 patients have been treated (2020-2021), the average annual number of beds was 1,160. While the number of hospital beds in 2020 (6 months) was 12, by 2021 this figure had increased to 29 due to newly developed treatment protocols, the experience of specialists, and the effectiveness of treatment measures. As a result, the average number of days patients spent in the hospital decreased from 12.4 days (2020) to 10.4 days (2021) (Table 4).

Table 4

Republican special infectious diseases hospital "Zangiota-2"

analysis of activity

Years	Total number of treated	Average annual number of seats	Number of days where patients lie	Seat swap	Average annual occupancy	The number of days in which one patient lies on average in the stationary
2020 (6 month)	13809	1160	174000	12	150	12,4
2021	34012	1160	353725	29	305	10,4

4. Conclusion

1. Widespread use of a prospective table that allows for a comprehensive assessment of the risk group among the population and patients will allow medical workers working in the ENT institutions and heads of healthcare institutions to develop scientifically based measures aimed at reducing the incidence of the disease, its early detection, diagnosis and adequate treatment.
2. Based on our analysis, the occupancy rate of positions in this hospital in 2021 was 95.6% for doctors, 57.5% for mid-level medical workers, and 52.2% for junior medical workers. From this we can conclude that mid-level medical workers and junior medical workers occupied almost half of the total staff.
3. Due to newly developed treatment protocols, the experience of specialists, and the increased effectiveness of treatment measures, the number of hospital bed changes decreased by 12 in 2020 (for 6 months), by 29 in 2021, and the average number of days of inpatient treatment decreased (12.4 in 2020, 10.4 in 2021).

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